

July 28, 1960

Dr. John S. Garing
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Dear Dr. Garing:

It was a real pleasure to talk to you at Pacific Grove and to look forward to further experimentation on IR spectra.

You asked me to comment more specifically on the spectral regions that would be most interesting to investigate and to find out particularly if there were any likely useful absorptions, relevant to biological material, in the IR window of the earth's atmosphere between roughly 8 and 13 microns. I have looked into this a little with the following conclusion: according to a paper by Levine et al, 1953, Journal of Bacteriology, 66:664-670, bacteria do show a moderate IR absorption band between about 1050 and 1150 cm^{-1} . This can mainly be attributed to glycogen, and I assume the abundance of secondary C-H-O-H groups are responsible for this absorption. Although glycogen, sugars, starch, and related compounds which should all show such an absorption are quite widespread -- and I should have, of course, included cellulose -- the presence of this absorption band would not be a particularly striking datum arguing for the presence of life since, of course, many other organic molecules would show the same characteristics. Perhaps even more important the absorption between 900 and 1100 cm^{-1} should be dominated by the very strong band of the silicates which might be expected to obscure absorptions by any organic materials. However, this might lead one to look at the expectations in a different way namely that the emission spectrum in this band should be indicative of the extent to which silicate rocks or sands are exposed or are covered by overlying material. At the very least a distinctive spectrum should be observed for water and for land masses. Insofar as the emission may dominate over the reflection at these longer wave lengths, the most interesting results might be obtained in the ozone band between 1000 and 1050 cm^{-1} from instruments flown at moderate altitudes beneath the ozone-absorbing layer. In some, while data for this window should have great general interest, it is not obvious a priori that they would contribute very much to biological detection.

As we had discussed before, the most promising spectral region would appear to be the one in which Sinton worked with wave numbers just under the 2962 line of methane. I would suspect that a spectral resolution of at least .1 microns would be essential but it might be important to consult with Dr. Calvin for his experimental laboratory reflection spectra before affirmatively deciding this point. Again the flight should be so designed as to establish whether one could distinguish water, vegetated, and arid terrain by the characteristic IR spectrum in this region. How useful laboratory measurements would be in predicting this result I do not know.

Mr. Derbyshire at the Space Science Board, National Academy of Sciences, has affirmed that he would be most interested to have copies of the publications of your group for distribution to the Board or to the more specially interested members thereof. He will be writing you about this. Permit me to express my own appreciation for the material you gave me and the hope that you will continue to keep me informed.

Yours sincerely,

Joshua Lederberg
Professor of Genetics